Food Quality & Safety
FARM TO FORK SAFETY

Maximizing Technology Advancements in Environmental Testing

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The Food Safety Modernization Act is now a reality as the rules' compliance dates have already started to roll out according to the published schedule. Food safety is a critical issue for all stakeholders in the production chain as the U.S. FDA is exercising its power and authority to bring federal criminal charges against companies and their management for food safety violations.

There is nowhere a company can hide from a food recall, whether it be voluntary or FDA enforced. Consumers and the legal profession are acutely aware of the food industry's product recalls in real time due to 24/7/365 connectivity of technology and speed of sharing interactive information.

As technology is increasing the food safety awareness and knowledge of consumers, it is also improving the food industry's ability to ensure that the food it provides is wholesome and safe. There are tremendous advancements in various technology platforms to support the food safety process at all stages throughout the production chain. These technologies range from enhancing "time-to-results" and accurate pathogen detection, supporting a company's Hazard Analysis and Critical Control Points and Hazard Analysis Risk-Based Preventative Controls plans, streamlining the audit process, delivering and monitoring continuous improvement on food safety education for employees, and accurately documenting food and supplier traceability, to name a few.

In particular, new technologies are now available to better monitor foodborne pathogens onsite and there are no excuses for processors not to improve their overall processing environment. All processors can start by introducing small changes in their food safety program that includes using better, more nutritive sampling devices, better performing enrichment media, and better detection methods. The ROI is almost immediate and results in improved process control, longer-term sanitation cost reduction, better production efficiency, and, most important, lowering the risk of releasing contaminated products to the market that could result in pathogen outbreaks.

Faster, Better Enrichment Method

One of the biggest and elusive culprits in food safety management is the environmental presence and growth of pathogens, such as *Listeria monocytogenes* or *Salmonella* spp., in the processing or manufacturing facility. Environmental testing for microbiological contaminants is a key component of hygiene monitoring and risk characterization practices utilized across diverse fields of application. When selecting a detection method, a sensitive procedure is necessary as the target pathogen numbers are very low and more likely to be injured after going through heat stress, cold stress, dehydration, starvation, etc. These injured bacteria can be incapable of growth because of structural or metabolic damage resulting from an underestimation of the true population of viable cells given false-negative results. They also become sensitive to selective components present in enrichment broth to which they normally show resistance. This could worsen when using a highly selective media because the inhibitory ingredients comprised in the formulation are optimized for the growth of populations from samples rich in nutrients and can be highly damaging for organisms adapted to low-nutrient conditions, such as the ones present on a surface. In this situation, some cells of the stressed bacterial population will not initiate growth while others will show a longer lag phase than healthy cells due to repair time. The resulting consequence is a real risk of not reaching the bacterial concentration for the detection of the pathogens within the enrichment duration. This explains why it is challenging to obtain appropriate enrichment conditions to provide a balance between recovery of the desired organism while avoiding the overgrowth of competing organisms.

When selecting an enrichment broth and enrichment conditions, it is important that the method is developed taking into consideration the complexity of the samples to enrich and the morphology state of the target pathogens. A nutritionally rich, semi-selective broth that supports the use of an enrichment technique is desired to improve and accelerate the recovery of stressed cells in a variety of samples. Enrichment times may vary based on the performance of the media in resuscitating weak or injured cells as well as the detection capabilities of the test assay in complex environment surfaces. Also, when making a decision to use any media, it is important to confirm that the medium has been validated to work with the desired test assay to lower the probability in obtaining false positive or negative results. Other parameters that are important to know are the specificity and the sensitivity of the media and the detection system.

Some of the features to look for when selecting an enrichment media are the ability to combine a nutritive base with the necessary ingredients to improve cell resuscitation and optimized selective agents to efficiently inhibit competing flora without affecting the growth of the target pathogen. These properties confer an important growth advantage when other bacteria are present in the samples taken from an unclean environmental surface. Furthermore, it is proven with validation studies that the enrichment time could be cut down by several hours when applying the right materials and growth conditions. An example of an enrichment media with these advantageous properties is FoodChek Systems Inc.'s ACTERO Enrichment Media developed for a single-step recovery and enrichment of stressed pathogens potentially present in environmental samples and in low quantities. This method allows for obtaining results in as little as 18 hours of enrichment for the detection of *Listeria* spp. on various surfaces and is reduced to

14 hours for *Salmonella* spp. Thus, it can be easy to integrate a robust environmental testing program based on next day results while ensuring the right food safety control.

Choosing the Right Test Technology

The surveillance and monitoring of pathogens in environmental surfaces should also be based on reliable and efficient detection technology that reinforces the effort to effectively prevent and control contamination. Several commercially available rapid methods using immunology-based assays or nucleic acid-based assays have been developed and validated that can now deliver reliable results within a few hours to a day. Rapid technologies are perceived as good value because they are accurate, easy to use, and faster than cultural methods. However, not all pathogen detection methods are the same and it can be easy to loose track of which technology best serves your environmental surface and food sampling. All have certifications of varying degrees, but practical, real-world performance offers a glimpse into some significant differences. These differences were not truly exposed in the past but now, in today's environment, may pose significant risk. For instance, while false positives are often focused on or attributed to a lack of culture, very few explore what the false negative risks may be since negatives are rarely cultured even during validation. These false negatives represent potential risk, hidden risk, and now a recall, legal, and financial risk. To avoid these risks, the processing with in-house testing capabilities or external service laboratories should consider many parameters when choosing the most acceptable method, or a combination of these methods, for their needs. The main parameters to examine when deciding to invest in testing technology are accuracy, precision, detection limit, ease-of-use, the nature of samples, cost acceptability, laboratory space, training of laboratory personnel, and quality of services after sale.

Implementing fully automated instruments that enhance the accuracy, speed, and efficiency of food safety testing through the detection of molecular pathogens, including *Listeria*, *Salmonella*, *Escherichia coli*, and other organisms potentially found in environmental and food sample contamination episodes, supports the business case of using innovative detection technology. Systems that are easy-to-use and incorporate advanced features minimize the complexity of the testing processes. Technologies that provide unparalleled scalability and reliability allow processors with in-house labs or service laboratories to meet the increasing demands of today's testing environment, as well as those of the future. An example of this are assays that target ribosomal RNA, and can also detect messenger RNA and DNA, providing the versatility of using the same technology for other nucleic acid testing applications. The combined power of technologies that these types of instruments use delivers a fully automated, single-protocol assay with reduced enrichment times and superior sensitivity. One such technology is Roka Bioscience, Inc.'s Atlas System that is based on this accurate molecular detection.

Bottom Line Benefits

Considerable progress is being made to shorten "time-to-results" of detection methods while maintaining or increasing sensitivity and specificity for detection of various pathogens, such as

Listeria monocytogenes, *Salmonella*, and *Escherichia coli*. When combining the right sampling device with the latest technology in performing enrichment media and an accurate detection system, it is possible to reduce the "time-to-results" without compromising accuracy, to have higher throughput to maximize operating efficiencies, and to obtain test results within a production shift while improving the efficiency and efficacy of the processors' sanitation program. Embracing the latest technologies in pathogen testing also enables food processors and manufacturers to liberate their products faster and deliver fresher foods in the marketplace, while protecting human and animal health. Additional research and development by media and test kit manufacturers continue to bring innovation and improvements to the detection methods available in the marketplace and help food processors protect their brand, management, and customers.

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